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ABSTRACT

This manual gives general control principles and specific information on control of mosquitoes, flies, bedbugs, fleas, lice, cockroaches, venomous arthropods, ticks and chiggers, and rodents. The specific information includes life-cycles and habitats, public health importance, non-chemical control, and control with pesticides. (BB)

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PUBLIC HEALTH PEST CONTROL

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SE 024 700

This training manual is intended to provide you with the information you will need to meet the standards of the Environmental Protection Agency for pesticide certification, and prepare you to take an examination given by the State Department of Agriculture based on this manual. It is not intended that this training will provide you with all the information you need for effective Public Health Pest Control. Additional information in the form of publications and short courses can be obtained from the Cooperative Extension Service.

Acknowledgment is made to the Bureau of Tropical Diseases, Center for Disease Control, Department of Health, Education and Welfare, Atlanta, Georgia, for many of the illustrations used in this manual.

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I. CONTROL PRINCIPLES

Many insects, mites, ticks, spiders (called collectively "arthropods"), and rodents that are of public health importance can be controlled by a variety of methods - such as sanitation practices, water management, mechanical methods, and pesticides. When insects and their relatives are involved in carrying a disease in an emergency situation, pesticides are usually the recommended control, due to the necessity for a rapid reduction of pest populations. Non-chemical means have a dominant and preferred role in control of many arthropods and rodents, but are usually too slow in emergency situations. The cost of pesticides and their usually quick but temporary control must be balanced with non-chemical methods that may give much longer-lasting reductions in pest populations - but may be initially more expensive.

Persons directing public health pest control programs must be able to assess their operation and determine that they are achieving their objectives without adversely affecting man or the environment. The importance of proper survey and identification techniques has great importance in order that the applicator may apply the correct control method at the proper time and place, and keep the use of pesticides at a minimum.

Balanced pest control programs require the support of other agencies - i.e., proper garbage collection and disposal for fly and rodent control, and design of impoundments and drainage ditches for mosquito control. Education of the general public and other agencies may be an essential element in getting the understanding necessary to carry out your objectives.

II. PESTS

A. Mosquitoes

1. Life Cycle and Habitats

Mosquitoes have four distinct stages in their life cycle; the egg, larva, pupa and adult. The first three stages occur in water. There are many different species or kinds of mosquitoes.

Each species will lay its eggs in its specific type of site. For example, various salt marsh mosquitoes will lay their eggs in

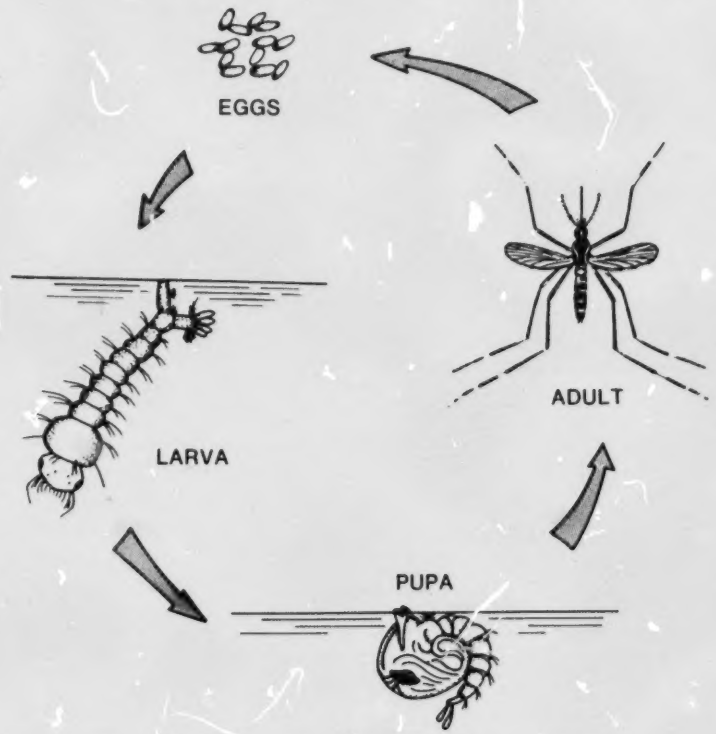


Figure 1. Life cycle of a mosquito

the damp sod of salt marshes; species preferring containers will lay their eggs in tree holes, tires, and various other artificial containers (cans, bottles, etc..); some species will prefer the polluted water (and others the clear water) of ditches, ponds and lakes; and some the temporary puddles of rain water. The eggs will hatch when they are in contact with water.

The larvae of all mosquitoes live in water. They are called "wigglers".

The pupae also live in the water, and unlike many insect pupae, are very active. They are called "tumblers".

After the adults emerge from the pupae, most females require a blood meal before laying eggs. Each species of mosquito prefers to feed on certain types of animals (such as birds or rodents) or even on a particular species of animal (such as horses, cattle, or man). Some species of mosquito will fly only a city block or two while others will fly up to 10 - 20 miles. Some are active during the day while others are active at night.

When mosquitoes are causing a public health problem, it is essential to conduct a survey to identify the species involved. Knowledge of the life cycle and habitat of the species involved is essential in order that control may be directed at the proper habitat at the right time.

2. Public Health Importance

Mosquitoes have probably had a greater influence on human health and well being than any other insect group. Mosquito bites are irritating and itch. Mosquitoes can interfere with outdoor activities, and decrease the value of property.

There are numerous diseases carried by mosquitoes that can cause severe illness or death in man. Most of those that once occurred in the United States (malaria, dengue and yellow fever) are no longer present. However, there is still one group that periodically appears. These are viral diseases that affect the central nervous system, causing encephalitis. There are several major types of encephalitis; the one found along the Atlantic and Gulf Coast States is called eastern encephalitis. This

disease normally occurs in various species of birds. Mosquitoes that prefer to suck the blood of birds carry the virus from bird to bird. Other species of mosquitoes that occasionally feed on birds, horses and man will cause the disease to "spill over" into human populations. The human death rate from this disease is high.

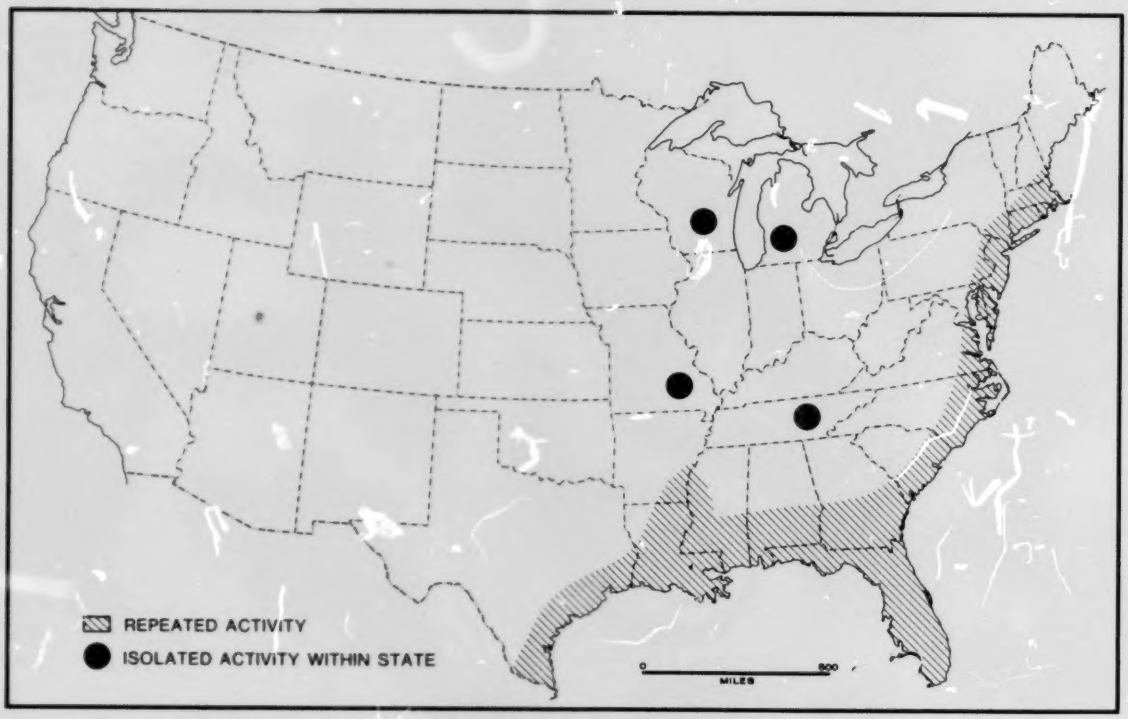


Figure 2. Locations of eastern encephalitis

3. Non-Chemical Control

The application of pesticides is a never ending cycle as long as favorable habitats are available for mosquito breeding. The initial investment in eliminating favorable aquatic breeding sites is high, but savings can be realized over time. Filling, draining, water management and the use of mosquito-eating fish are well developed

techniques that can be very effective. In filling, draining or water management operations, expert advice should be available to prevent environmental problems. For example, filling may block drainage patterns creating new breeding sites or interfering with aquatic life. Draining can be done in many ways; the depth of the drains, their placement and location can create more mosquito breeding plus result in changes in vegetation that affect wildlife if incorrectly done. Water management (i.e., the creation of steep banks on impoundments and ponds to reduce the area for the growth of aquatic vegetation, and fluctuating the water level to control vegetation and to allow fish access to mosquito larvae) often involves other interests - fishing, recreation, water for drinking and electrical power - and these interests must be consulted. Remember, non-chemical methods have been used successfully for many years - much longer than most pesticides have been available. There is a great deal of information available to enable you to achieve your objectives and to safeguard environmental and other interests even though compromises may sometimes be necessary.

Non-chemical control of adult mosquitoes is more limited. Screening of dwellings and the wearing of tightly woven clothing are the best.

4. Control with Pesticides

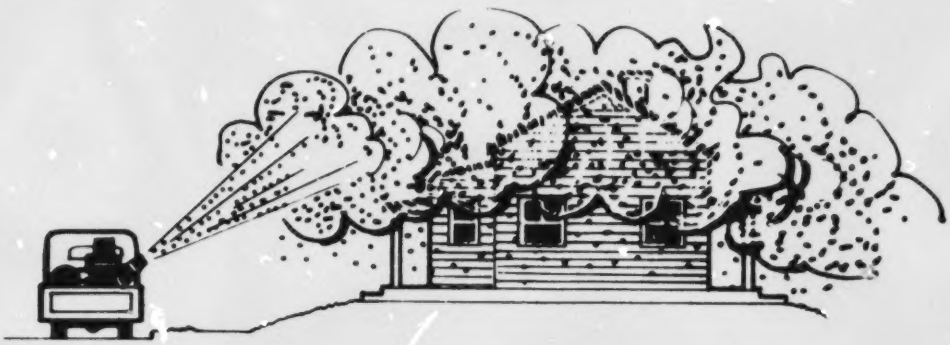
a. Continuous vapor dispensers

A formulation of dichlorvos in wax or resin allows the gradual release of insecticidal vapors over an extended period of time. This type of treatment is effective against adult mosquitoes in enclosed areas such as home, catch basins, and cisterns. These vapor dispensers should not be used where infants or the aged are continuously exposed, or in areas where food is prepared, served or stored. See the label.

b. Space treatments

Space treatment in the forms of fogs, mists, ultra-low volume (ULV) and dusts can be very effective in quickly reducing adult mosquito populations. This is the most common control technique used when large mosquito populations become serious pests, or in emergency situations such as in an outbreak of encephalitis.

In urban space spraying for mosquitoes, the city block is the unit treated. Mists are directed over the house tops while fogs are kept as near to the ground as possible. Due to their larger particle size, mists are generally more suitable for daytime use, while fogs, with much finer droplets, should be applied only when updrafts from the warm earth or water are minimal, usually mid-morning, or evening.



MIST IS DIRECTED OVER HOUSETOPS

FOG IS KEPT AS NEAR THE GROUND AS POSSIBLE

Figure 3. Application of mists and fogs in urban adult mosquito control.

The chief advantages of mists and fogs are:

(1) economy of operation

(2) small amounts of pesticide are needed to cover a large area

(3) large areas can be rapidly treated during emergencies

The chief disadvantages of mists and fogs are that cars and windows may be spotted and shrubbery burned from the oil when the spraying is not done properly. Fogs are usually preferred to mist applicators in urban mosquito programs due to their smaller particle size and the lower likelihood of spotting automobiles and "burning" vegetation. However, fogs can cause serious traffic hazards.

Ultra-low volume (ULV) spraying is the application of a technical grade (concentrated) pesticide. With some pesticides this may be as low as 0.5 ounces per acre. In ULV spraying, the technical pesticide is applied in a particle size similar to fogs and aerosols. A major advantage is the application of relatively small amounts of concentrated pesticide. ULV applications are more inexpensive since diluents are eliminated and since larger areas can be treated on a single tank of pesticide. The use of concentrated or technical material, however, does increase the hazard of causing damage to automobile finishes if the particle size is not kept small enough.

Dusts can be used as a space application, but is more difficult to control their particle size and they are more subject to drift into non-target areas.

Honey bees are especially susceptible to pesticide drift.

There are a variety of different small portable power duster-misters, and larger truck-mounted power duster-misters.

Mechanical fog generators break the insecticide up into small particles by expelling it between discs turning at high speed.

Thermal fog generators break up the insecticide in small particles by means of hot exhaust gases. There are many different types of small portable generators available as well as are large truck mounted models. The smaller units can be used in city parks, summer camps and other small areas; the larger units are used in treating urban areas. Oil solutions must be used as emulsions do not make satisfactory thermal fogs.

The "cold fogger" is another type of mechanical fog generator that uses a special nozzle. The "cold fogger" has several advantages over that of thermal fog generators:

(1) no visible fog to cause traffic hazards

(2) no potential breakdown of the pesticide from the heat

(3) reduction of costs by being able to use water emulsions rather than oil solutions.

Ground ULV generators are available in a variety of sizes. ULV generators are usually smaller and lighter than the heavier thermal fogger, cold fogger or ground mist machines.

c. Repellents

A number of chemical repellents are available for personal protection and can be very effective.

d. Larvicides

While there are three life stages of the mosquito in the water (egg, larva and pupa) most treatments are directed against the larval stage. The eggs and pupae are more resistant to chemical treatment. Proper

identification of the species to be controlled, knowledge of its habitat, and the proper timing of applications are essential to good control.

The degree of pollution and amount of vegetation in the water will influence the effectiveness of pesticide applications. Heavily polluted water may require more frequent applications to maintain mosquito larvae control. Granular formulations may be preferred in heavy vegetation since they will penetrate the foliage better than solutions or emulsions. Both emulsions and oil solutions of a pesticide can be used, the latter is particularly effective in water with high organic content (or polluted). ULV aerial applications have been very successful in treating large areas under water. Petroleum oils (No. 2 fuel oil, and Flit MLO) were one of the first larvicides developed and are now again being widely used. They are effective against mosquito eggs, larvae, and pupae.

Due to the repeated applications of the organochlorines and organophosphates for larvicides, many species of mosquitoes have become resistant to these chemicals. Unfortunately, a resistant larva that emerges is also a resistant adult. Since using the same pesticide for adults and larvae may cause resistance to develop faster, it is usually recommended that different chemicals be used for control of adults and larvae. It has become a common practice in many areas to use the petroleum oils for larviciding since:

(1) egg, larva and pupa do not become resistant to this chemical
(2) environmental hazard to aquatic life is reduced
(3) organophosphates and carbamate compounds can be used for adulticiding only, thereby delaying the development of resistance.

B. Flies

1. Life Cycle and Habitats

There are four stages in the life cycle of a fly: the egg, larva, pupa and adult. The larval habitat chosen by the adult female differs with different species.

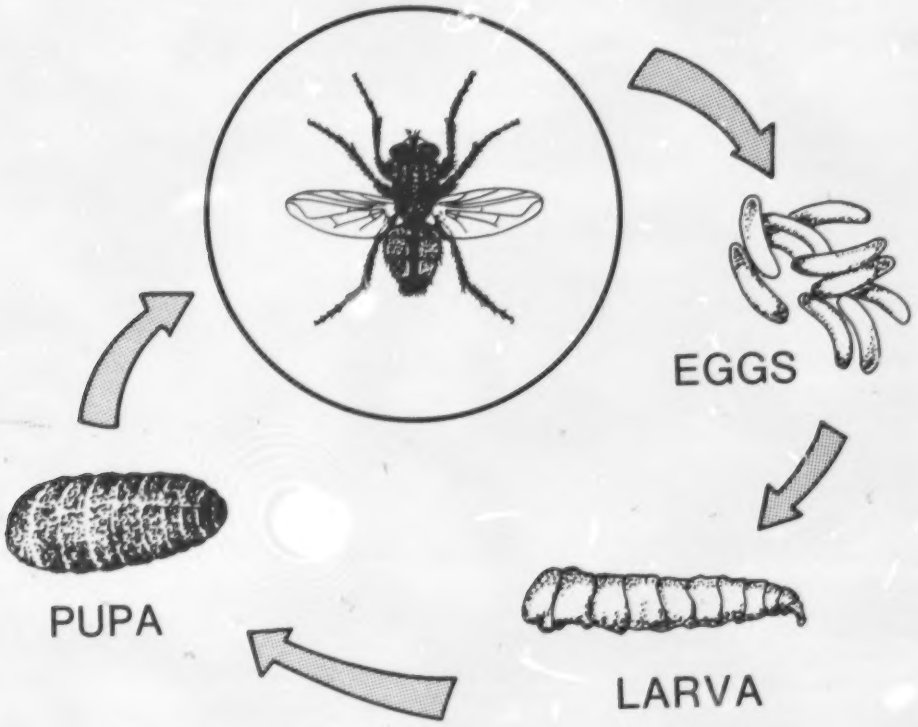


Figure 4. Life cycle of the house fly.

Many flies (such as house flies, stable flies and deer flies) of public health interest to man lay their eggs in decaying organic matter - human garbage and waste, manure of domesticated animals, and decaying vegetation. After the eggs hatch, the larvae feed upon organic material, and in a few days to several weeks develop into the inactive stage, the pupa. The pupal period may last from a few days to several weeks, after which the adult fly emerges.

Some flies, such as the house fly, have sponging mouthparts; others (such as deer and stable flies) have biting or piercing mouthparts. Some

flies can fly many miles from the breeding site.

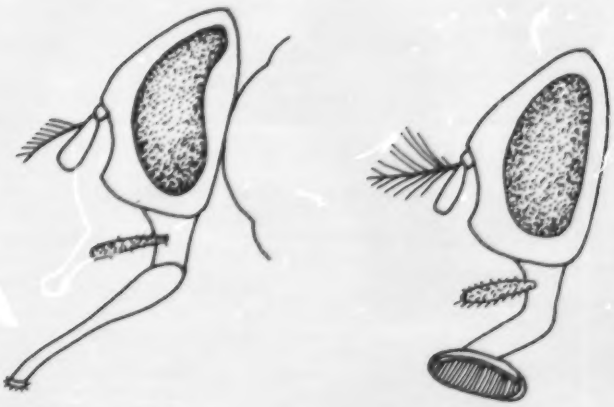


Figure 5. Piercing and sponging mouthparts of flies

It is essential that the applicator make proper identification of the species of the fly he wishes to control. Larval breeding sites and habits of the adult must be known in order that control efforts may be directed toward the proper target area.

2. Public Health Importance

Flies, especially in large numbers, can be very annoying and seriously interfere with work and recreation activities. Biting flies (such as stable flies and deer flies) cause pain and discomfort. In addition, since flies often lay their eggs and feed on decaying organic material (garbage, sewage, waste), they can transfer disease organisms to table food which in turn is consumed by man.

Figure 6. Transmission of disease by flies to man

3. Non-Chemical Control

The removal of fly breeding sites near human habitations is the best remedy. This will include proper covering of garbage cans and collecting garbage at least twice a week from residences, and daily from business establishments. If flies do gain access to the garbage, they will be removed before a new generation reaches the adult stage.

Garbage should be buried in a sanitary landfill. Incinerators may be practical for large cities where landfills are too remote; however, unless they are properly constructed they may contribute to air pollution problems. Sanitary disposal of sewage and industrial wastes is essential in a fly control program. Open sewage pits and wastes

Figure 7.
Removal of Garbage.

from canneries, feed mills and packing houses are sources of heavy fly breeding. Adequate disposal methods should be available at the plant, or holding facilities should be available from which wastes can periodically be trucked cut to a sanitary landfill.

It is essential that public health agencies secure the support of other governmental agencies that will be involved with the disposal of these wastes.

Mechanical control through screening, fly traps, electrocution devices and electric fans over doorways is another way that flies may be controlled. A combination of chemical and environmental sanitation methods are usually the most successful elements in a fly control program.

4. Control with Pesticides

a. Residual treatment

Because flies reproduce rapidly, the use of long-lasting residual insecticides has tended to select out resistant individuals relatively rapidly. Adult resistance in some species of flies has resulted after only a season or two of use of a pesticide.

Bait stations consist of an attractive food plus a pesticide poison. They may give impressive reductions of fly populations, but successive treatments and maintenance is necessary for continued control.

b. Larvicides

Where there are accumulations of garbage, manure, rotting vegetation or other wastes and large numbers of fly larvae, a larvicide is commonly used. Larvicide applications often do not penetrate the organic matter enough to kill where many of the larvae are. Larvicides frequently break down rapidly due to the effects of the organic matter. Parasites and predators of the flies are destroyed, and the use of pesticides in such an environment encourages resistance. Sanitation practices for removing fly breeding areas and chemical treatment of adults is usually a more satisfactory program then complete dependence on chemical control.

C. Bedbugs

1. Life Cycle and Habitats

The bedbug has three stages in its life cycle; egg, nymph (which is very similar in appearance to the adult - except smaller) and adult. Bedbugs are usually well hidden, but their presence may be recognized by their characteristic odor, blood stains from squashed bugs, and excretory spots - often found near the site of feeding. The eggs are laid and other stages of the bedbug are found in baseboards, wall

crevices, bedsteads, and mattresses. Bedbugs have piercing mouthparts and feed on the blood of humans. They may spread from infested areas to uninfested ones by stowing away in such things as furniture, bedding, clothing, baggage, and theatre seats.

Figure 8. Adult bedbug.

2. Public Health Importance

Bedbugs have not been identified as disease carriers, but they do cause irritating bites.

3. Control with Pesticides

A single application of insecticide in their breeding sites will usually control bedbug infestations. Only a light application should be given mattresses and upholstery - not a soaking spray. Infant bedding and crib should not be treated with insecticide.

D. Fleas

1. Life Cycle and Habitats

There are four life stages: the egg, larva, pupa and adult. They are small wingless, bloodsucking insects with piercing mouthparts. Adults are usually very active and can move on and off a host to obtain a blood meal. Most species infest small animals (such as mice, rats or squirrels) but some prefer larger animals and birds. Animals that burrow or nest are favored since they provide shelter to the temperature sensitive adults, and organic food for the larvae.

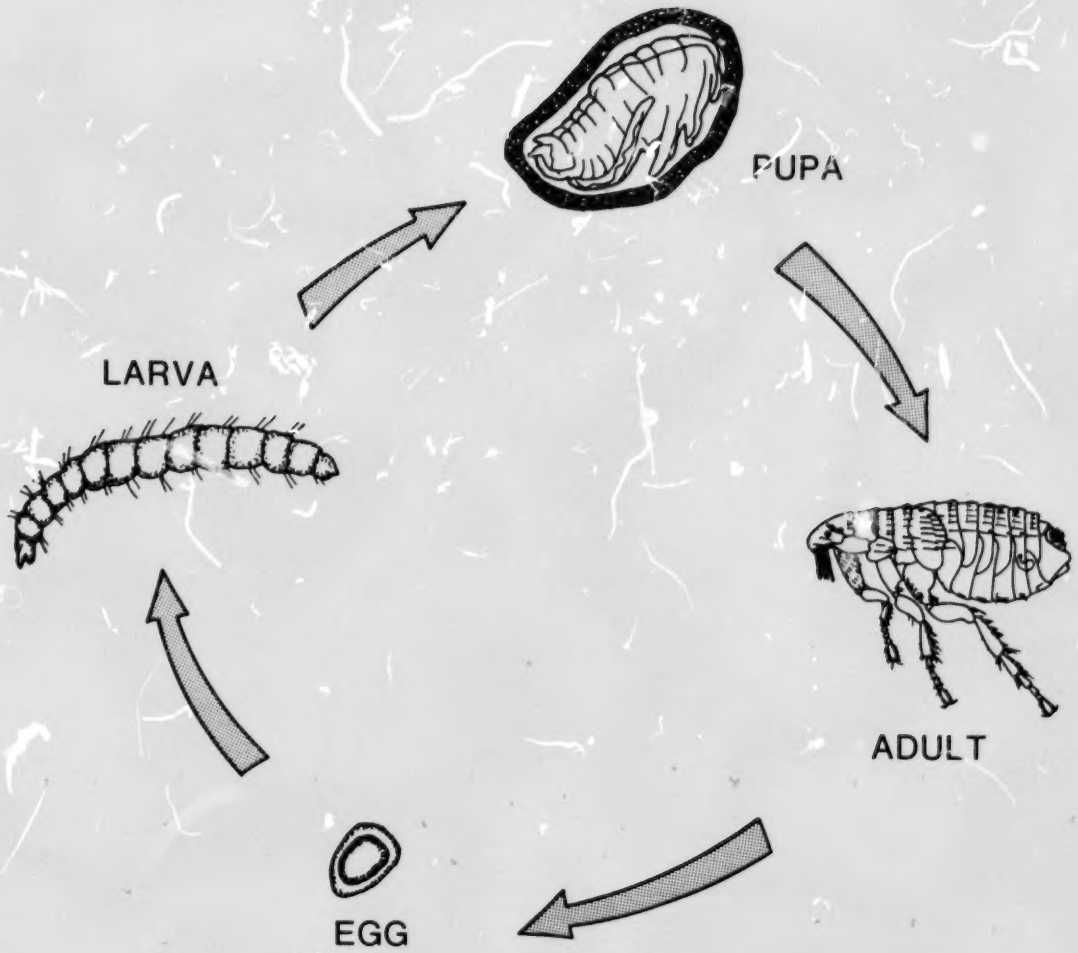


Figure 9. Life cycle of a flea

Eggs are usually laid loosely on the host. They fall off and the larvae emerge in a few days to several weeks. They feed on organic material - especially in the nest or bedding of the host where they eventually pupate. If the host dies or leaves a nesting area and fails to return, the adult fleas will actively seek a new host.

2. Public Health Importance

There are several species of fleas that live on rats. When rats die (as from a disease or a rodenticide) or for some reason fail to return to their nest, then rat fleas are most likely to bite man.

Flea bites may be very irritating to some people. They can occur in disturbingly large numbers in yards and homes, especially when the normal host (often a dog or cat) has been absent for a few weeks.

There are two important diseases that fleas can transmit from infected rats to man: plague and fleaborne typhus. They rarely occur in epidemics now.

3. Control with Pesticides

The principal method of flea control on either cats, dogs or rodents is the use of insecticides.

Various types of insecticides of plant origin, organochlorines, organophosphates and carbamates are available as dusts for flea control. Oil solutions, wettable powders, and emulsions are also available for treating the premises. It is essential to read the label carefully since some insecticides are for dogs only, and some are for premise treatment only - not animals. The favorite resting place of pets needs treatment since eggs, larvae and pupae will commonly be found here. Various types of resin collars impregnated with an organophosphate give good flea control. Dusts and wettable powders are the safest to use around plants and bushes; emulsions, and especially solutions, may "burn" plants if label directions are not followed carefully.

Reducing flea populations on domestic rats is best accomplished by reducing the rat populations with a combination of rat killing, rat proofing, sanitation and clean-up.

E. Lice

1. Life Cycle and Habitats

Sucking lice have three stages in their life cycle: egg, nymph, and adult. There are three different species of lice that occur on man. Head lice live mainly on the head and neck, and cement their eggs called "nits" to the hairs close to the scalp. Body lice live mainly in the clothing except when feeding and lay their eggs in the seams of the clothing. Crab lice lay their eggs on the body hairs; live mainly among the pubic hairs but are also found on hairy areas of the chest and armpits.

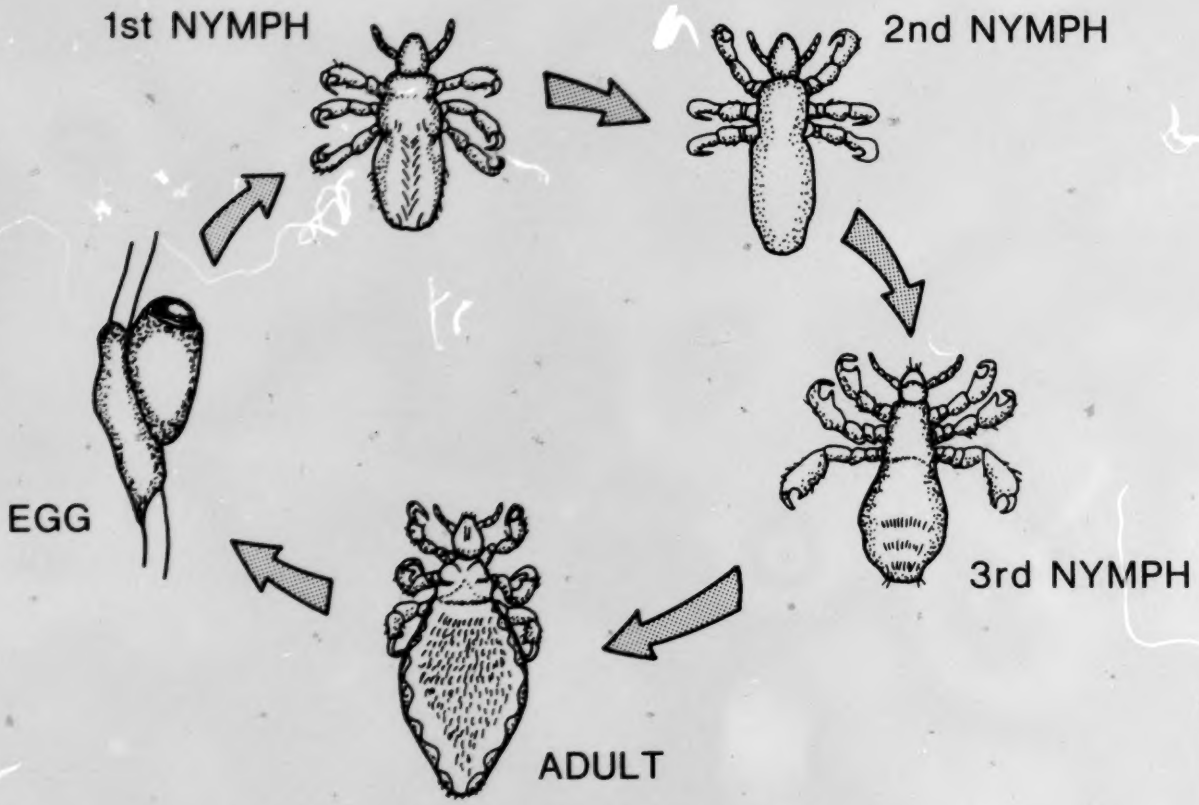


Figure 10. Life cycle of head louse

All three species of lice suck blood, and usually spend their

entire life cycle on man. Body and head lice spread mainly by personal contact between people and exposed to infested clothing. Head lice may be acquired in schools and taken home to infest other family members. Crab lice spread mainly by sexual contact, but may also be acquired from infested toilet seats and beds.

Figure 11. Crab louse

2. Public Health Importance

Epidemic or louse borne typhus is carried to man by the body louse, but has not been present in the United States for many years.

Pediculosis is a skin condition resulting from continuous and severe infestation of lice. A scarred, hardened and pigmented skin results from scratching secondary infections and louse bites. All three kinds of human lice can cause pediculosis.

Human lice are generally associated with lower socio-economic conditions, however, anyone can become infested. This can result in discomfort and embarrassment.

3. Control with Pesticides

The three species of lice that infest man differ considerably in habits and as a result require different methods of control.

The body louse spends most of its life on the clothing, except when it is feeding. Laundering with hot water or dry cleaning will destroy all stages of this louse in the clothing.

Insecticidal dusts can be used for all three kinds of lice. While dusts can be unsightly, they are probably the most efficient louse control method (clothing need not be removed). Liquid preparations for the infested areas such as shampoos, lotions and emulsions are usually more acceptable. Some of these can be secured only on a physician's prescription. Since you will be applying pesticides directly to the skin, and many pesticides are absorbed through the skin, it is essential that the product be labelled for the purpose of louse control.

F. Cockroaches

1. Life Cycle and Habitats

Cockroaches have three life stages: egg, nymph, and adult. The eggs are deposited in a capsule (many eggs are in one capsule). These hatch into tiny nymphs - similar to the adults, but without wings. These nymphs then develop into adults with wings. There are several species of cockroaches that are well adjusted to living in close association with man. They live in cracks and crevices, and come out to feed on bits and pieces of food.

Cockroaches are fond of starchy foods and will feed on such materials as cereals, bakery products, book bindings, wall paper, beer, cheese and leather. Most cockroaches come out only at night to feed. They are most commonly found around food handling areas, preferring warm moist situations - such as cracks and crevices near stoves, sinks, water pipes, drains and garbage cans.

2. Public Health Importance

Cockroaches give off fluids that impart an unpleasant odor to food and areas they infest. They can carry a variety of diseases from sewers and garbage cans to the food of man. They vomit-up food while feeding, deposit feces loaded with bacteria, and spoil far more food than they eat.

Figure 12. Transmission of disease to man by cockroaches

3. Non-Chemical Control

Sanitation in food handling areas is essential. Floors, counters and shelves should be kept clean. Food should be adequately covered or sealed. The design of food handling areas is very important in allowing cleaning of all floors, counters, and surface areas. Cracks and crevices should be sealed.

4. Control with Pesticides

There are several organochlorine, organophosphate, carbamate and botanical pesticides labelled for use against cockroaches. It has become common practice to apply one or more of these chemicals with small hand sprayers on a routine basis to baseboards, cracks, crevices and other harborage areas. Label directions should be carefully followed to avoid contaminating food and food handling surfaces. To obtain a quick kill a pyrethrum aerosol should be used just prior to a residual treatment. The constant exposure of cockroaches to these pesticides has resulted in resistance to many of them.

G. Venomous Arthropods

Injury from venoms from stinging or biting insects and spiders is a common public health hazard. Aside from the discomfort of the poison, some people are very sensitive to it and will have a severe reaction. Honey bees, spiders and wasps have caused more deaths than snake bite each year. Nests that are built in or near dwellings or working or recreational areas can cause a problem - especially to children.

Although all spiders possess biting mouthparts and venom (or poison) only two are of any serious importance to man in most States - the black widow spider and the brown recluse spider. The black widow will often make her web under buildings, in piles of old lumber or brick, in basements or greenhouses and in privies. The bite is extremely painful and sometimes fatal if not treated by a physician.

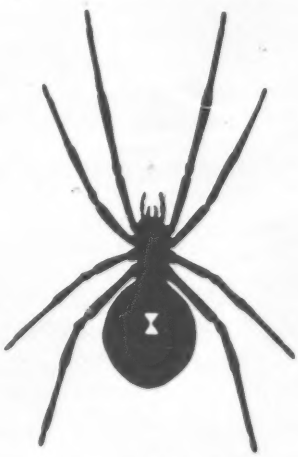


Figure 13. Black widow spider

The brown recluse spider favors storage areas - such as closets and attics. The poison of this spider kills the tissue surrounding the site of its bite. This can cause serious tissue damage and scarring, but rarely death.

Figure 14. Brown recluse spider

Direct spot treatment of nests with a liquid or dust is commonly used. For larger recreational, surburban, and sometimes agricultural areas (fire ants), pesticides in baits are the most practical. The method of application differs with the pest and the pesticide; label directions must be carefully followed to avoid injury to children and non-target animals.

H. Ticks and Chiggers

1. Life Cycle and Habitats

Ticks and chiggers (mites) are not insects, but they are closely related to them. Both ticks and chiggers are parasites that feed on a variety of hosts.

Ticks have four stages in their life history - egg, larva, nymph, and adult. The female tick will usually drop to the ground from a host, and lay her eggs on or near the earth. These then hatch into larvae or "seed ticks". Some "seed ticks" will climb up on vegetation and wait for a passing rodent on which to attach. Others will actively seek a host, being guided by the odor of the animal. After the larvae

or "seed ticks" have fed, they may or may not drop off the host (depending on the species), but in any case they will shed their skins and emerge as 8-legged nymphs. The nymph will again attach to a host, feed, drop off, shed its skin, emerge as an adult, and attach to another host. The number and variety of hosts, and the length of time between stages differs among different species of ticks. The adult female will drop from the host after a blood meal, and lay her eggs. Adult ticks are usually found outside, but some species may be found in homes in large numbers after being introduced by dogs.

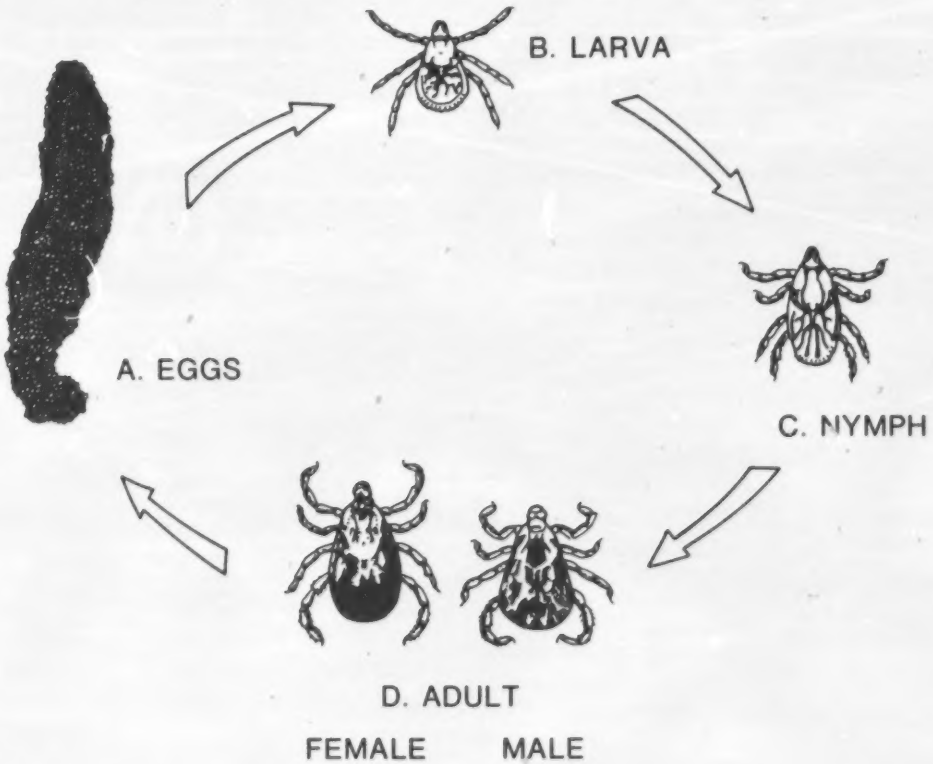


Figure 15. Life cycle of tick

Many species of mites are pests on agricultural crops, some are parasites on domestic animals, and a few are parasitic on man. One of the most common of the latter is the chigger mite. The chigger goes through the egg, larva, nymph and adult stages. It is only the larval

stage that is parasitic on man and other animals. The small, red adult mites lay their eggs in the spring and by mid-summer the eggs hatch into 6-legged larvae that actively seek a variety of hosts. They will crawl upward, and frequently stop where they encounter an obstacle - such as a tight garter or belt. The chigger inserts its mouthparts and sucks juices from the skin. The digestive fluids from the chigger results in severe itching. Mites from rats and mice, birds, flour and grain, and herbaceous plants may infest homes and some will cause skin irritation.

Figure 16.
Adult chigger

2. Public Health Importance

The bite of the tick and chigger is irritating, often causing itching, and infection can occur from the wound.

Spotted fever is the most important disease carried by a tick (American dog tick) to man in the eastern states. Recovery is often slow and the death rate is high in some untreated groups.

3. Non-Chemical Control

Chiggers do not like open dry areas that permit sunlight and air to circulate. Close-cut lawns, well kept paths, and the elimination of tall weeds and shrubs - particularly blackberries and raspberries that furnish food for rodent and bird hosts of chiggers - will help to reduce chigger mites.

4. Control with Pesticides

Various organochlorines, organophosphates and carbamates are labelled for tick control and organochlorines for mite control.

Selected tratement in areas most frequented by humans and dogs - paths, trails, picnic sites - may be more practical than area wide treatment. In treating outdoor areas, avoid application to ponds, streams and other bodies of water since some of the pesticides labelled for use will be toxic to fish. When organochlorines are considered a hazard due to the possibility of environmental damage, the organophosphates and carbamates should be used.

In treating indoors for tick infestations, the spray or dust is applied as a spot treatment to baseboards, floors and wall crevices, window frames, and other harborage sites - such as the sleeping quarters of the dog, and the animal itself. Be certain the insecticide is labelled for indoor use against ticks. A different chemical may be necessary to treat the dog - read the label.

I. Rodents

1. Life Cycle and Habitats

There are three common species of rodents that live in close association with man; the Norway rat, the roof rat, and the house mouse. These are sometimes called domestic rodents.

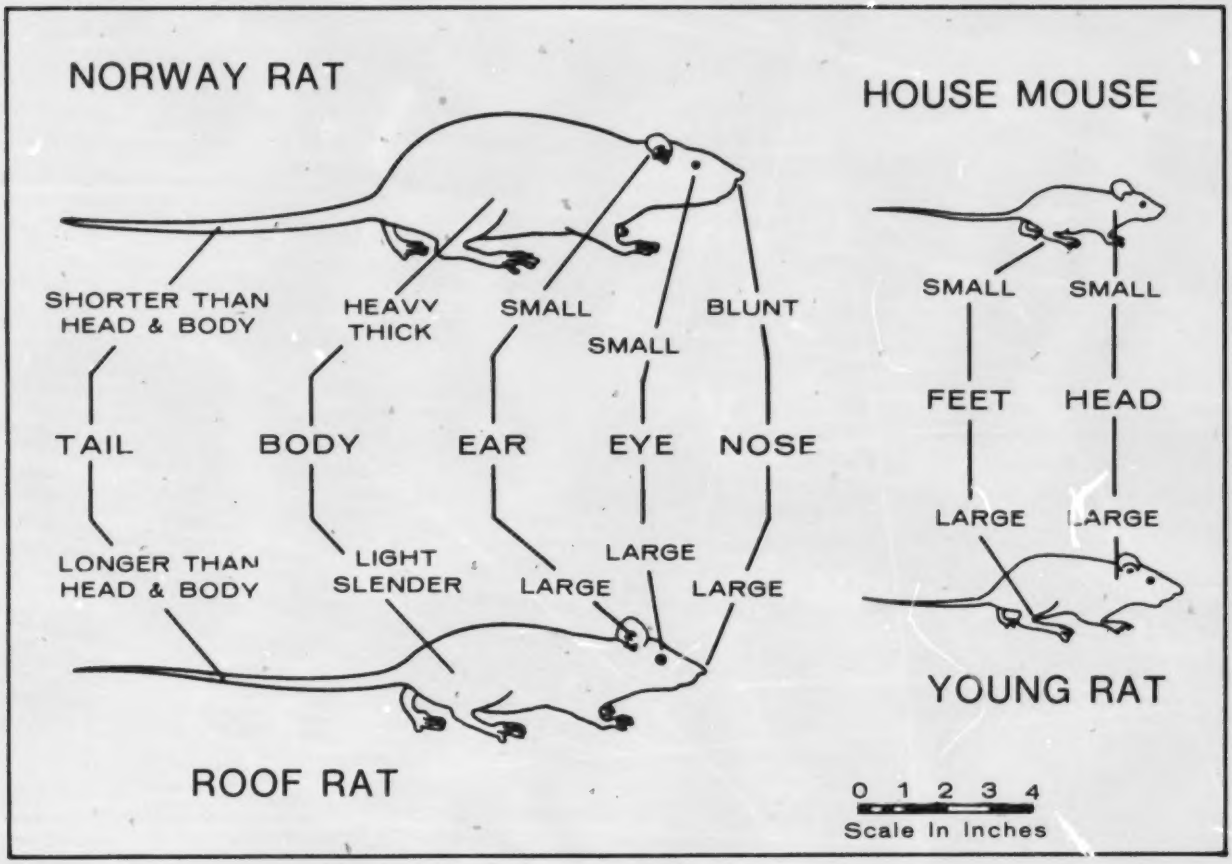


Figure 17. Identification of domestic rodents

The roof rat is an excellent climber and will usually prefer the upper parts of human structures in which to live. The heavier Norway rat likes to burrow under trash, embankments with heavy grass and under buildings. The house mouse often builds her nest in buildings. All three species are secretive, and are usually most active at night. The Norway rat may have well-worn paths outside from its burrow to its food supply. These rodents do not like to travel in the open any more than necessary and usually have their nests close to their food supply. The presence of rodent droppings is a good indication

that these pests are nearby. The number of rats and mice in a given area is directly related to the amount of food, water, and harborage areas available. If any one or more of these three is significantly reduced, there will be a reduction in the rodent population.

2. Public Health Importance

Domestic rodents destroy by partially eating, urinating on and dropping feces on far more food than they actually eat. In lower socio-economic areas with poor sanitation, rats will bite infants especially if they have food on their faces or hands and are not kept clean. Rats carry a variety of diseases that can attack man, but most of these are very uncommon today.

3. Non-Chemical Control

The use of rodenticides alone is never ending, expensive, and sometimes not very successful. The use of chemicals should be joined with improved sanitation. Rats will not stay, nor build-up to large numbers where food and harborage are not available. Garbage should be kept in covered cans, and picked up regularly. Every effort should be made to bar rats from food - this may include rat-proofing buildings to prevent their entry. Even where food is available and cannot be readily removed - as in a grain elevator, the reduction of harborage alone will reduce rat populations. The storage of materials off the floor on racks, cutting the grass, removing trash, storing materials on cement slabs will all help to reduce nesting areas - and rats and mice.

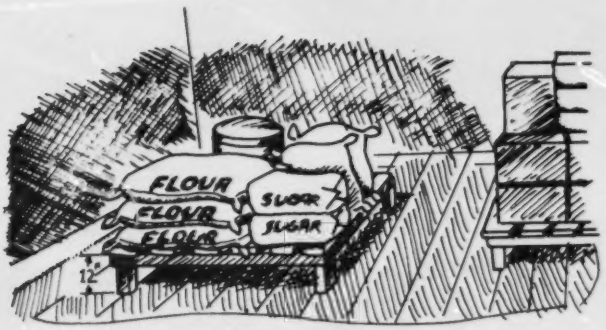


Figure 18. Proper storage of bulk food.

4. Control with Pesticides

a. Anticoagulant rodenticides

Anticoagulant poisons are commonly used to kill rats. A rat must consume at least a small amount of this poison each day for several days. Since repeated feedings are necessary to kill a rat, permanent bait stations are needed. Resistance of some rat populations to those compounds has been noted in Georgia, North Carolina, Virginia and other areas. Anticoagulant poisons are relatively safe to use around children and pets. These rodenticides can be mixed with dry baits, water, or included in wax in damp situations - such as sewers and drains.

b. Single-dose rodenticides

Single-dose rodenticides kill with a single dose and are valuable in rapidly reducing a rodent population. These baits take less time to maintain than the anticoagulants and use less bait material, but most are poisonous and some extremely so to humans and pets. There are several fumigants (such as calcium cyanide) that can be very successfully used in rodent burrows, but only by well-trained personnel.

Figure 19. Foot pump for fumigation of rodent burrows with calcium cyanide

c. Baits

Rats will not just eat anything. They have their preferences as do you. The same species of rat may prefer different kinds of foods in different areas and at different times. All this means that before a baiting program with a single-dose rodenticide is begin, it is essential that the baits used be acceptable to the rats. For this reason, "pre-baiting" is commonly recommended. The rat is given a choice of several bait materials (such as yellow corn meal, bacon, rolled oats or corn) that are unpoisoned. Once a successful bait has been identified, you are ready to begin using a pesticide with it. Improper placement may fail to give satisfactory results. Where a variety of food is readily available to rats, a liquid bait may be preferred. Baits must be kept fresh; dirty or moldy baits are not attractive to rats.

d. Traps and rat-proofing

Traps, either baited or unbaited, are widely used. Rat-proofing can be effective in preventing the entry of rodents into buildings.

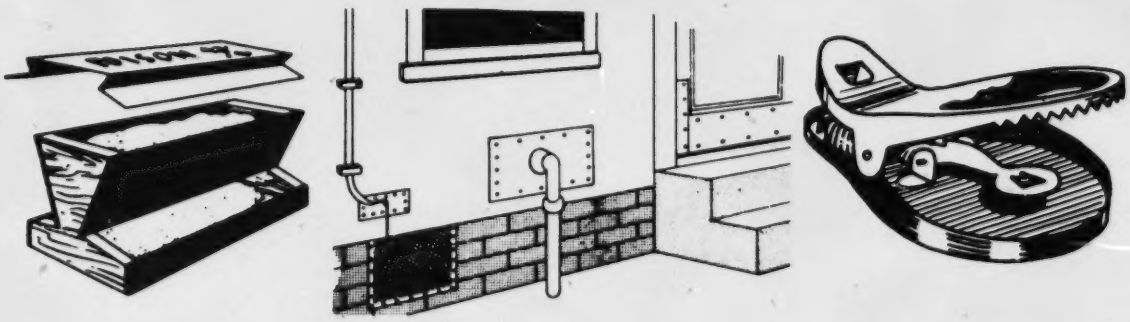


Figure 20. Bait station, rat-proofing, and a mouse trap

5. House Mice

The use of many small well-distributed baits is more successful than a few large ones. Since mice tend to nibble, a slightly higher concentration of anticoagulants for mice will be needed than for rats. Liquid anticoagulants for mice are not very successful. Snap traps baited with an aromatic bait such as peanut butter is a successful and inexpensive mouse control technique.

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